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IS 1001 (1991): Synthetic Rubber Proofed/Coated Fuel Pump
Diaphragm Fabric [PCD 13: Rubber and Rubber Products]



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IS 1001 : 1991

(Reaffirmed 2012)

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(पहला पुनरीक्षण)

Indian Standard

SYNTHETIC RUBBER PROOFED/COATED
FUEL PUMP DIAPHRAGM FABRIC —
SPECIFICATION

(*First Revision*)

UDC 621.43.032 : 677.6 - 408.2

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BUREAU OF INDIAN STANDARDS
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FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Coated Fabrics Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

This standard was first published in 1956 and covered synthetic rubber proofed and varnish-proofed fabrics. However, in this revision only synthetic rubber proofed/coated fabrics are being covered as there is a remote possibility of manufacture of varnish-proofed fabrics in the country. Consequently the title of the standard has been amended.

Furthermore in the earlier version, requirements were covered in two parts, namely, Part A Qualification tests and Part B Identification Tests. Under the qualification tests, constructional details and mass of the base fabric and proofed fabrics; breaking strength of the base fabric and proofed fabric and details of proofing composition besides bursting strengths, Bench rig test resistance to fuel were covered. Under product identification, tests like acetone extract, chloroform extract, alcoholic potash extract, rubber combined sulphur, carbon black, ash and determination of total synthetic oil resistant type rubber were covered.

In this revision an attempt has been made to make this standard performance oriented rather than composition specific. For this reason only performance requirements like breaking strength elongation at break, accelerated ageing, resistance to liquid, resistance to oil, low temperature test and Bench rig test have been retained with necessary modifications to update the standard.

The performance of diaphragm is usually specified in terms of pressure displacement response and in a precision pumping operation the displacement of a diaphragm determines the volume of liquid displaced. For small movements the flat diaphragm consisting of a disc of rubberized fabric is adequate. The movement which this type of diaphragm provides occurs almost totally as a result of the extensibility of the reinforcing fabric.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (revised)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

SYNTHETIC RUBBER PROOFED/COATED FUEL PUMP DIAPHRAGM FABRIC — SPECIFICATION

(*First Revision*)

1 SCOPE

This standard prescribes the requirements and the methods of sampling and test for fuel diaphragm fabric, synthetic rubber proofed/coated used for the manufacture of fuel pump diaphragm for motor vehicles run on gasoline up to 100 RON (Research Octane Number) not containing more than 20 percent by volume of aromatic hydrocarbons and commercial diesel fuel.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard :

<i>IS No.</i>	<i>Title</i>
3400 (Part 6) : 1983	Methods of test for vulcanized rubbers : Part 6 Resistance to liquid (<i>first revision</i>)
4905 : 1968	Methods for random sampling
7016 (Part 1) : 1982	Methods of test for coated and treated fabrics : Part 1 Roll characteristics (<i>first revision</i>)
(Part 2) : 1981	Part 2 Determination of breaking strength and extension at break (<i>first revision</i>)
(Part 10) : 1981	Part 10 Low temperature bend test

3 REQUIREMENTS

3.1 Material

3.1.1 Rubber

The rubber used for the manufacture of diaphragms shall be nitrile or any polymer suitably compounded so that the finished product conforms to the requirements specified in this standard.

3.1.2 Reinforcement Fabric

The basic fabric used for the manufacture of the diaphragm shall be made from suitable grade of polyamide fabrics so that finished product conforms to the requirements specified in this standard.

3.2 Construction, Workmanship and Finish of Proofed/Coated Fabric

The reinforcement fabric shall be suitably treated to ensure satisfactory bond between rubber and fabric. The rubber compound shall be applied evenly on both sides and shall have a smooth finish free from pin holes and other visual flaws when viewed under a magnification of $\times 10$. Diaphragms shall be manufactured according to the shape and dimension as agreed to between the purchaser and the supplier.

3.3 The diaphragms shall comply with the requirements laid down in Table 1.

3.4 Accelerated Ageing

Three specimens of size 75 mm $\times$ 25 mm cut from the diaphragm fabric shall be subjected to accelerated ageing at $100 \pm 1^\circ\text{C}$ in an air oven, minimum for 72 hours. After keeping in ambient condition for 30 minutes, the test specimens shall be folded 10 times to 180° . No visible cracks shall develop.

3.5 Resistance to Liquid

Specimen of size 75 mm $\times$ 25 mm shall be immersed in liquid consisting of equal parts by volume of 2, 2, 4-trimethylpentane and toluene for $24 + 0$ hours at $27 \pm 2^\circ\text{C}$. The increase in

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volume determined in accordance with IS 3400 (Part 6) : 1983 shall not exceed 50 percent. The loss in mass of the specimen after drying for 2 hours at $80 \pm 1^\circ\text{C}$ shall not exceed 5 percent.

3.5.1 The increase in volume and loss in mass after drying, after immersion in absolute

alcohol using the method indicated in 3.5 shall not exceed 35 percent and 5 percent respectively.

3.6 Resistance to Oil

After immersion in ASTM Oil No. 1 or its equivalent at $100 \pm 2^\circ\text{C}$ minimum for 72 hours in accordance with IS 3400 (Part 6) : 1983, the increase in volume shall not exceed 10 percent. The material shall retain its surface smoothness without sticking.

3.7 Low Temperature Test

When kept for 72 hours minimum at -20°C , no cracks shall develop when folded over a mandrel 3 mm in diameter as per IS 7016 (Part 10) : 1981.

3.8 Bench Rig Test (Endurance Test)

The diaphragm shall work satisfactorily when tested in accordance with Annex A.

3.8.1 The endurance test as per Annex A is a type test consisting of Stage I for test duration of 500 h and Stage II of 400 h. Stage I and II shall be performed for product approval and acceptance test shall constitute Stage I. Stage I and II shall be repeated after certain time interval as agreed to between the purchaser and the supplier. The purchaser, however, at his discretion reserve the right to conduct both Stages I and II during acceptance of supplies.

4 MARKING AND PACKING

4.1 The material shall be supplied in rolls or sheets as agreed to between the purchaser and the supplier.

4.1.1 In case the material is supplied in rolls, each roll shall be marked legibly and indelibly at intervals of 25 cm along the length and breadth of the roll with the manufacturer's name, initials or recognized trade mark, if any; the month and year of manufacture of the materials and the use of the material.

4.1.2 In case the supply is made in sheets, each sheet shall be marked legibly and indelibly along one edge of the sheet with the details of marking specified under **4.1.1**.

4.2 The material may also be marked with the Standard Mark.

4.3 The material shall be thoroughly dusted with French chalk on both sides and shall be packed with an interleaving of paper.

5 TEST METHODS

Tests shall be carried out as prescribed in Annex A and relevant Indian Standards mentioned in this standard.

6 SAMPLING

The scale of sampling and criteria for conformity of diaphragm fabric shall be as prescribed in Annex B.

Table 1 Requirements for Diaphragm

(Clause 3.3)

Sl No.	Characteristic	Requirement	Method of Test, Ref to IS
(1)	(2)	(2)	(4)
i)	Thickness, mm	0.40 ± 0.04	7016 (Part 1) : 1982
ii)	Mass, g/m ²	450 ± 50	7016 (Part 1) : 1982
iii)	Breaking strength, kgf/5 cm, <i>Min</i> :	1	7016 (Part 2) : 1981
	a) Warp direction	175	
	b) Weft direction	175	
iv)	Elongation at break, percent, <i>Max</i> :		7016 (Part 2) : 1981
	a) Warp direction	40	
	b) Weft direction	40	

ANNEX A

(Clause 3.8 and 5.1)

BENCH RIG TEST

A-1 APPARATUS

A-1.1 Characteristics

The apparatus shall conform to the following characteristics.

A-1.1.1 Suction Pipe

8 mm outer diameter $\times$ 6.34 mm inner diameter or nearest standard size.

A-1.1.2 Suction Head

0.50 ± 0.01 metre.

A-1.1.3 Delivery Pipe

8 mm outer diameter $\times$ 6.34 mm inner diameter of nearest standard size.

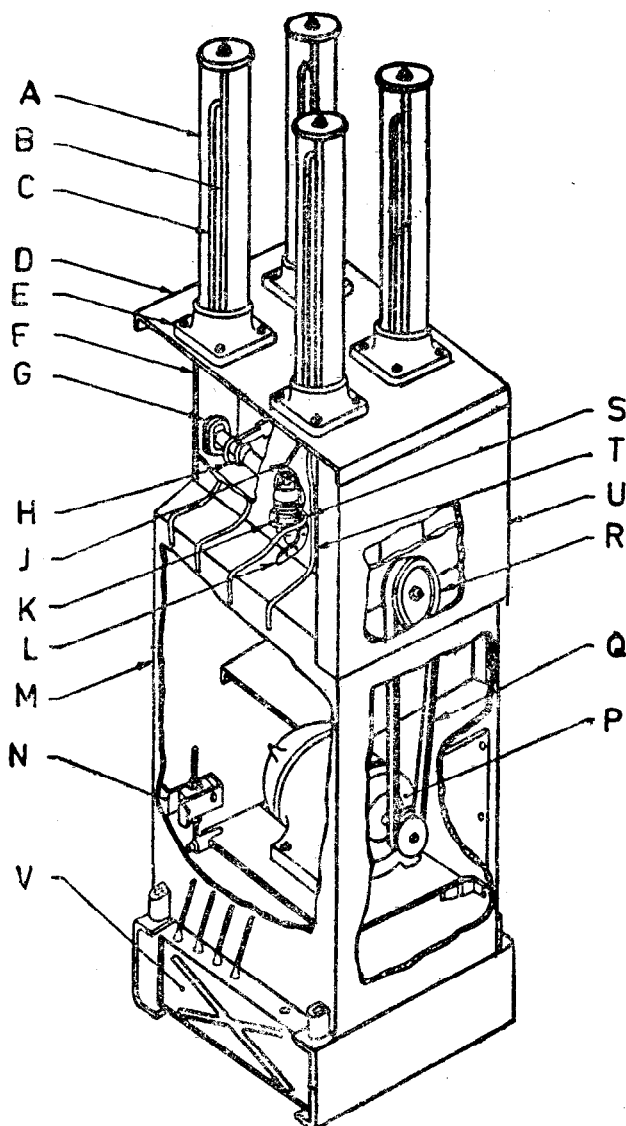
A-1.1.4 Delivery Head

0.50 ± 0.01 metre.

A-1.1.5 The diaphragms should actuate at the rate of 1 440 to 1 500 times per minute. (A 4 pole 50 Hz A. C. induction motor yields this actuation rate.)

A-1.2 An isometric view of a typical apparatus is shown in Fig. 1 but any apparatus conforming to the characteristics specified under A-1.1 is acceptable.

A-1.3 The machine consists of four mechanical transport fuel pumps, fitted in the top box *F* mounted on the bottom box *M* which in turn is mounted on a fuel tank *V*. Each pump *K* is arranged to draw fuel independently through a separate suction pipe line *S* from the fuel tank at the base against a suction head of 0.50 m and to pump the fuel through delivery pipe *J* into a glass cylinder *A* against a delivery head of 0.50 m. The cylinder is clamped to the top cover *D* by means of a centre tie rod *B* and a glass tube base *E*. The fuel from the cylinders returns to the fuel tank through return pipe line *T*. A four throw camshaft *H* connected to the pump and driven by an electric motor *P* through belt *Q* and pulley *R*, the ratio of the latter and the speed of the motor being such that the camshaft rotates at 1 440 to 1 500 rpm. Alternatively the camshaft may be directly driven by an electric motor at the above speed.



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|--|---|
| <i>A</i> = Glass cylinder for fuel | <i>M</i> = Bottom box |
| <i>B</i> = Centre rod | <i>N</i> = Arrangement for adjusting belt tension |
| <i>C</i> = Delivery pipe | <i>P</i> = Electric motor |
| <i>D</i> = Top cover | <i>Q</i> = 'V' belt |
| <i>E</i> = Base glass tube | <i>R</i> = Camshaft pulley |
| <i>F</i> = Top box | <i>S</i> = Suction pipe |
| <i>G</i> = Bearing block | <i>T</i> = Return pipe to Fuel tank |
| <i>H</i> = Cam shaft | <i>U</i> = Cover |
| <i>J</i> = Delivery pipe | <i>V</i> = Fuel tank |
| <i>K</i> = Fuel pump with diaphragm under test | |
| <i>L</i> = Pump Primng lever, if provided | |

FIG. 1 APPARATUS FOR FUEL PUMP DIAPHRAGM TEST RIG

A-1.4 The cam circle diameter, the eccentricity of the cam used and the relative geometrical location of the pump mounting face with respect to the camshaft axis in the endurance test rig shall conform to exact details of the engine on which the pump is intended to be used.

A-1.5 The fuel used shall be as described under scope depending on the application of the pump.

A-2 PROCEDURE

A-2.1 The diaphragm material shall be tested for endurance on the specific design of pump inclusive of the lever for which it is intended.

A-2.2 For the purpose of test, the diaphragm layers in the punched cut form in number and shape to conform to the original design of the pump, and assembled in the form of diaphragm spindle assembly consisting of diaphragm, upper and lower washers, spindle and springs conforming the original design, shall be used. Each pump shall be fitted with one such diaphragm assembly, taking care that the joints are air tight. Check the speed of the

camshaft and allow the fuel to flow continuously at the maximum rate. Run the machine as many hours a day as maintenance conditions permit and test the samples for a total of 500 hours and observe whether the sample remains serviceable during this period on the test rig. Make observations from time to time to see that the machine is operating satisfactorily. Tighten the clamping screw of the pump at regular intervals during the test and replenish the fuel to compensate for losses due to evaporation. Because of the likelihood of the composition of fuel to change during the test period, it is desirable to replace the fuel with a fresh quantity every 50 hours of operation or three days whichever is earlier.

A-2.3 When the material under test develops defects and can no longer function satisfactorily, air bubbles appear in the fuel flow (which may be observed in the glass cylinder). The pumping also would be erratic. Insufficient fuel and/or a leak in the suction line and/or a leak in the suction side of the pump may lead to erratic running. These possibilities should be investigated and eliminated before concluding that diaphragm may have developed defects, which may be subsequently confirmed by visual inspection of the diaphragm layers.

ANNEX B

(Clause 6.1)

SAMPLING PLAN FOR FUEL PUMP DIAPHRAGM FABRIC

B-1 LOT

All the rolls/sheets manufactured continuously from the same material under similar conditions of production shall be grouped together to constitute a lot.

B-2 NUMBER OF SAMPLES

Each lot shall be tested to the requirements of this standard. The number of samples to be drawn from each lot depends upon the size of the lot and shall be in accordance with Table 2.

B-2.1 Each roll/sheet in the sample as per Table 1 shall be selected at random from the lot. For this purpose reference may be made to IS 4905 : 1968.

B-3 Criteria from Conformity

Each roll/sheet selected in the sample shall be

tested for workmanship and finish requirements, thickness and mass. A roll/sheet failing to meet any or more of these requirements shall be termed as defective. The lot shall be considered as conforming to the requirements of these characteristics if the number of defectives in the samples is less than or equal to the corresponding acceptance number given in Table 2.

B-3.1 The lot which has been found as conforming to the requirements of B-3 shall then be tested for the requirements of breaking strength and elongation at break. For this purpose 5 specimen for lots of size up to 25 rolls (or 1 000 sheets) and 8 specimen for lots of size more than 25 rolls (or 1 000 sheets) shall be cut from the rolls/sheets already selected as per Table 2 and tested. The lot shall be considered as conforming to these requirements if no defective is found in the sample.

B-3.2 The lot which has been found as conforming to the above requirements shall then be tested for the requirements of accelerated ageing, resistance to liquid, resistance to oil, and low temperature test. For this purpose 2 specimens from a lot shall be tested. The lot

shall be considered as meeting these requirements if no defective is found.

B-3.3 The lot shall be considered as conforming to the requirement of this standard if **B-3**, **B-3.1** and **B-3.2** are satisfied.

Table 2 Scale of Sampling

(Clause B-2)

Lot No.	For Rolls		Lot No.	For Sheets	
	Sample Size	Acceptance No.		Sample Size	Acceptance No.
Up to 15	13	0	Up to 300	50	2
16 to 25	20	0	301 to 500	80	3
26 to 100	32	1	501 to 1 000	125	5
101 and above	50	2	1 001 to 3 000	200	7
			3 001 to 10 000	315	10
			10 001 and above	500	14

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